

WHAT IS CLAIMED IS:

1. A multilayered article comprising:

(1) a substrate (S);

(2) a scratch-resistant layer (SR) prepared by curing a scratch-resistant coating composition comprising a polycondensate prepared from at least one silane, said polycondensate being prepared by a sol-gel process; and

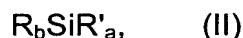
(3) a top layer (T) prepared by curing a top layer coating composition prepared by hydrolysing a composition comprising,

(a) at least one compound represented by general formula I,



wherein M is an element selected from the group consisting of Si, Ti, Zr, Sn, Ce, Al, B, VO, In and Zn, R' represents a hydrolysable radical, and m is an integer from 2 to 4; and

(b) optionally at least one compound represented by general formula II,



wherein the radicals R' and R are the same or different, R' is as defined for general formula (I), R represents a group selected from an alkyl group, an alkenyl group, an aryl group, a hydrocarbon group with at least one halogen group, an epoxide group, a glycidyloxy group, an amino group, a mercapto group, a methacryloxy group and a cyano group, and a and b independently of one another have a value from 1 to 3, provided that the sum of a and b is four,

wherein said scratch-resistant layer is interposed between said substrate

and said top layer.

2. The multilayered article of Claim 1 wherein said substrate comprises a plastic.

5

3. The multilayered article of Claim 1 wherein the polycondensate of the scratch-resistant coating composition is prepared from methylsilane.

10

4. The multilayered article of Claim 1 wherein the polycondensate of the scratch-resistant coating composition is prepared from a composition comprising 10 to 70 wt.% silica sol, and 30 to 90 wt.% of a partially condensed organoalkoxysilane, in a solvent mixture comprising at least one aqueous solvent and organic solvent.

15

5. The multilayered article of Claim 1 wherein the polycondensate of the scratch-resistant coating composition is prepared from at least one silyl acrylate.

20

6. The multilayered article of Claim 1 wherein the scratch-resistant coating composition further comprises methacryloxypropyl-trimethoxysilane and AlO(OH) nanoparticles.

25

7. The multilayered article of Claim 1 wherein the polycondensate of the scratch-resistant coating composition is prepared from at least one multifunctional cyclic organosiloxane.

30

8. The multilayered article of Claim 1 wherein the hydrolysis of the composition of the top layer coating composition is conducted in the presence of at least 0.6 mole of water, based on 1 mole of hydrolysable radicals R'.

5 9. The multilayered article of Claim 1 wherein during the hydrolysis of the composition of the top layer coating composition, the compound of formula II is present in an amount of less than 0.7 mole, based on 1 mole of the compound of formula I.

10 10. The multilayered article of Claim 1 wherein the hydrolysis of the composition of the top layer coating composition is conducted at a pH of less than 6.0.

 11. The multilayered article of Claim 1 wherein the solids content of the top layer coating composition is 0.2 to 15 wt.%.

15 12. The multilayered article of Claim 1 wherein the hydrolysis of the composition of the top layer coating composition is conducted in the presence of a solvent selected from at least one of water, an alcohol having a boiling point below 120°C and an alkoxy-alcohol.

20 13. The multilayered article of Claim 1 wherein M of formula (I) is selected from the group consisting of Si, Ti, Zr, Sn and Ce, and m is 4.

 14. The multilayered article of Claim 1 wherein M of formula (I) is selected from the group consisting of Al, B, VO and In, and m is 3.

25 15. The multilayered article of Claim 1 wherein M of formula (I) is Zn, and m is 2.

16. The multilayered article of Claim 1 wherein the hydrolysable radical R' of formulas (I) and (II) is selected from the group consisting of halogens, C₁₋₄-alkoxy, C₆₋₁₀-aryloxy, C₁₋₄-acyloxy and alkylcarbonyl.

5 17. The multilayered article of Claim 1 wherein formula (I) is selected from at least one tetraalkoxysilane.

10 18. The multilayered article of Claim 1 wherein formula (II) is selected from at least one of glycidyloxy-propyl-tri-methoxy-silane, methyltriethoxysilane and methacryloxy-propyl-trimethoxysilane.

15 19. The multilayered article of Claim 1 wherein after completion of the hydrolysis of the composition of the top layer coating composition a hydrolysis product is formed and, at least one of:

at least one additive selected from the group consisting of flow control agents, dyestuffs, stabilizers and inorganic fillers is added to the hydrolysis product; and

the concentration of the hydrolysis product is adjusted to 0.02 to 15 wt.% by adding at least one of alcohols and alkoxy-alcohols to the hydrolysis product.

20 20. The multilayered article of Claim 1 wherein the scratch-resistant layer has a thickness of 0.5 to 30 μm .

25 21. The multilayered article of Claim 1 wherein the top layer has a thickness of 0.1 to 3.0 μm .

30 22. The multilayered article of Claim 1 further comprising a primer layer (P) interposed between said substrate and said scratch-resistant layer.

23. A process of preparing a multilayered article comprising the following steps:

(a) providing a substrate;

(b) forming a scratch-resistant layer by applying a scratch-resistant coating composition to a surface of said substrate, and partially curing the applied scratch-resistant coating composition, said scratch-resistant coating composition comprising a polycondensate prepared from at least one silane, said polycondensate being prepared by a sol-gel process; and

(c) forming a top layer by applying a top layer coating composition to the scratch-resistant layer, said top layer coating composition being prepared by hydrolysing a composition comprising,

(i) at least one compound represented by general formula I,

$$M(R')_m \quad (I)$$

wherein M is an element selected from the group consisting of Si, Ti, Zr, Sn, Ce, Al, B, VO, In and Zn, R' represents a hydrolysable radical, and m is an integer from 2 to 4; and

(ii) optionally at least one compound represented by general formula II,

$$R_bSiR'_a, \quad (II)$$

wherein the radicals R' and R are the same or different, R' is as defined for general formula (I), R represents a group selected from an alkyl group, an alkenyl group, an aryl group, a hydrocarbon group with at least one halogen group, an epoxide group, a glycidyloxy group, an amino group, a mercapto group, a methacryloxy group and a cyano group, and a and b

independently of one another have a value from 1 to 3, provided that the sum of a and b is four; and

(d) curing said scratch-resistant and top layers.

5 24. The process of Claim 24 further comprising drying the scratch-resistant layer at a temperature of greater than 110°C, after the application of the scratch-resistant coating composition to said substrate.

10 25. The process of Claim 24 wherein the scratch-resistant coating composition comprises flow control agents present in an amount of 0.01 to 3.0 wt.%.

15 26. The process of Claim 24 wherein the top layer coating composition is applied at a relative humidity of 50 to 75%.

20 27. The process of Claim 24 further comprising, curing the scratch-resistant layer, activating the cured scratch-resistant layer by applying at least one of a corona treatment and a flame treatment to a surface of the cured scratch-resistant layer, and applying said top layer coating to the activated scratch-resistant layer.

25 28. The process of Claim 24 further comprising, applying a primer layer (P) to the substrate, and applying the scratch-resistant coating composition to the primer layer.